

Claims

1. A solenoid valve, comprising:
a valve housing supporting a coil;
a ball in the valve housing;
a valve seat in the valve housing; and
a rod reciprocatingly disposed in the valve housing between a deenergized configuration, wherein the coil is deenergized, the ball is against the valve seat, and the rod is distanced from the ball by between one tenth and eight-tenths of a millimeter (0.1mm-0.8mm) inclusive, and an energized configuration, wherein the coil is energized and the rod is urged against the ball to move the ball away from the valve seat.
2. The valve of Claim 1, wherein the valve housing defines the valve seat and is made integrally with a winding bay, the coil being wound in the winding bay.
3. The valve of Claim 1, wherein the rod includes a shaft and a pin engaged with the shaft and contacting the ball when the rod is in the energized configuration, the pin being made of a material that is harder than the shaft.
4. The valve of Claim 3, wherein the pin is made of a ferromagnetic material and the shaft is made of a non-ferromagnetic material.

5. The valve of Claim 1, further comprising a plunger staked to a portion of the rod, at least a part of the portion of the rod being formed with grooves.

6. The valve of Claim 1, further comprising a plunger engaged with a portion of the rod, the rod defining a ball contact end, the rod being formed with first and second guiding surfaces between the ball contact end and portion and defining a first diameter, the rod being formed with a stepped region intermediate the first and second guiding surfaces and defining a second diameter smaller than the first diameter.

7. The valve of Claim 1, wherein the valve housing is formed with at least one ball retainer rib defining a supply port having a first diameter, the ball being disposed between the rib and valve seat and defining a second diameter larger than the first diameter such that the rib retains the ball from passing outward through the supply port.

8. The valve of Claim 1, wherein the valve housing is formed with at least one supply port, the ball being disposed between the supply port and valve seat, the valve housing also defining a control port and an exhaust port, fluid communication being blocked through the supply port and established through the exhaust and control ports in the deenergized configuration, fluid

communication being blocked through the exhaust port and established through the supply and control ports in the energized configuration.

9. The valve of Claim 1, further comprising a vehicle fluid system communicating with the valve.

10. A solenoid valve for a vehicle, comprising:

a housing holding a rod, a ball, and a valve seat therebetween, the rod being disposed in the valve housing when in a deenergized configuration to permit the rod, when moving toward an energized configuration, to pre-travel a distance before contacting the ball that is sufficient to reduce a response time of the valve compared to a response time when the rod contacts or is very near to the ball in the deenergized configuration.

11. The valve of Claim 10, wherein the rod is distanced from the ball by between one tenth and eight-tenths of a millimeter (0.1mm-0.8mm) inclusive in the deenergized configuration.

12. The valve of Claim 10, wherein the valve housing defines the valve seat and is made integrally with a winding bay, a coil being wound in the winding bay.

13. The valve of Claim 10, wherein the rod includes a shaft and a pin engaged with the shaft and contacting the ball when the rod is in the energized configuration, the pin being made of a material that is harder than the shaft.

14. The valve of Claim 13, wherein the pin is made of a ferromagnetic material and the shaft is made of a non-ferromagnetic material.

15. The valve of Claim 10, further comprising a plunger staked to a portion of the rod, at least a part of the portion of the rod being formed with grooves.

16. The valve of Claim 10, further comprising a plunger engaged with a portion of the rod, the rod defining a ball contact end, the rod being formed with first and second guiding surfaces between the ball contact end and portion and defining a first diameter, the rod being formed with a stepped region intermediate the first and second guiding surfaces and defining a second diameter smaller than the first diameter.

17. The valve of Claim 10, wherein the valve housing is formed with at least one ball retainer rib defining a supply port having a first diameter, the ball being disposed between the rib and valve seat and defining a second

diameter larger than the first diameter such that the rib retains the ball from passing outward through the supply port.

18. The valve of Claim 10, wherein the valve housing is formed with at least one supply port, the ball being disposed between the supply port and valve seat, the valve housing also defining a control port and an exhaust port, fluid communication being blocked through the supply port and established through the exhaust and control ports in the deenergized configuration, fluid communication being blocked through the exhaust port and established through the supply and control ports in the energized configuration.

19. The valve of Claim 10, further comprising a vehicle fluid system communicating with the valve.

20. A valve for a vehicle, comprising:

a housing forming a valve seat;

seat blocking means in the valve housing and movable toward and away from the valve seat for selectively blocking the valve seat;

actuation means in the valve housing for moving the valve seat blocking means; and

energization means in the valve housing and controllable to move the actuation means against the valve seat blocking means, wherein

the actuation means is configured and disposed such that it builds up substantial momentum under the influence of the energization means when moving toward the valve seat blocking means, prior to contacting the valve seat blocking means.

21. The valve of Claim 20, wherein the valve seat blocking means is a ball, the actuation means includes at least a rod, and the energization means is a coil.

22. The valve of Claim 21, wherein the rod is reciprocatingly disposed in the valve housing between a deenergized configuration, wherein the coil is deenergized, the ball is against the valve seat, and the rod is distanced from the ball by between one tenth and eight-tenths of a millimeter (0.1mm-0.8mm) inclusive, and an energized configuration, wherein the coil is energized and the rod is urged against the ball to move the ball away from the valve seat.

23. The valve of Claim 21, wherein the valve housing defines the valve seat and is made integrally with a winding bay, the coil being wound in the winding bay.

24. The valve of Claim 21, wherein the rod includes a shaft and a pin engaged with the shaft and contacting the ball when the rod is in the

energized configuration, the pin being made of a material that is harder than the shaft.

25. The valve of Claim 21, further comprising a plunger staked to a portion of the rod, at least a part of the portion of the rod being formed with grooves.

26. The valve of Claim 21, further comprising a plunger engaged with a portion of the rod, the rod defining a ball contact end, the rod being formed with first and second guiding surfaces between the ball contact end and portion and defining a first diameter, the rod being formed with a stepped region intermediate the first and second guiding surfaces and defining a second diameter smaller than the first diameter.

27. The valve of Claim 21, wherein the valve housing is formed with at least one ball retainer rib defining a supply port having a first diameter, the ball being disposed between the rib and valve seat and defining a second diameter larger than the first diameter such that the rib retains the ball from passing outward through the supply port.

28. The valve of Claim 21, wherein the valve housing is formed with at least one supply port, the ball being disposed between the supply port and

valve seat, the valve housing also defining a control port and an exhaust port, fluid communication being blocked through the supply port and established through the exhaust and control ports in the deenergized configuration, fluid communication being blocked through the exhaust port and established through the supply and control ports in the energized configuration.

29. The valve of Claim 21, further comprising a vehicle fluid system communicating with the valve.